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ISSUED FEBRUARY 28, 1907

TERRITORY OF HAWAII
BOARD OF AGRICULTURE AND FORESTRY

DIVISION OF ENTOMOLOGY
ALEXANDER CRAW, SUPERINTENDENT

REPORT

OF THE

DIVISION OF ENTOMOLOGY

FOR THE YEAR ENDING
DECEMBER 31, 1906

REPRINT FROM THE THIRD REPORT OF THE BOARD OF COMMISSIONERS OF AGRICULTURE AND FORESTRY

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1907

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NOTICE FROM THE DIVISION OF ENTOMOLOGY.

The Entomological Division of this Board wishes to inform Hawaiian readers of this report that it is always ready and anxious to receive, study and report upon any insects that they may find and submit. When feasible either colonies of beneficial insects will be sent, or simple, inexpensive remedies will be prescribed. No charge.

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DIVISION OF ENTOMOLOGY.

Report of Superintendent of Entomology and Inspector.

Honolulu, T. H., December 31st, 1906.

To the

Honorable Board of Commissioners of
Agriculture and Forestry,
Honolulu, T. H.

GENTLEMEN:—I take pleasure in submitting to you a brief synopsis of the work done by your Division of Entomology during the year 1906.

INSPECTION OF IMPORTATIONS.

During that period we have boarded 355 steam and sailing vessels from which were discharged and inspected 202,374 packages of fruits and vegetables from outside the Territory, out of which we returned or destroyed 697 packages infested with injurious insects or plant diseases. Beside the above we received 77 bales and cases of plants and trees that we fumigated with hydrocyanic acid gas. By mail there arrived 603 packages of small plants and seed. Even in such small packages we found and preserved samples of injurious insects and diseases that would have been established on these Islands if not intercepted.

INFESTED JAPANESE RICE.

During the months of September and October we found importations of the old crop of Japanese rice to be infested with larvae of a small brown beetle (*Tenebroides mauritanicus*) and numbers of "Rice weevils" (*Calandra oryza*). The former is only found in the fall in old rice, and shipment of this rice was forbidden, by cable, to be sent here. Upon the arrival of the new crop rice in November it was found to be entirely free from the above pests.

Upon the arrival of the first shipment of "old crop" rice which was found infested, we were granted permission by Acting Collector of Customs, R. C. Stackable, to make a thorough test of fumigating the rice in the sacks, with carbon bi-sulphide in one of our large fumigating chambers, with a strength of half a pound of the bi-sulphide to every 100 cubic feet of enclosed space. After an exposure of twenty-four hours we found the fumes had penetrated the sacks and rice, killing both larvae and weevils. At your request and by courtesy of the Hon. James Wilson, Secretary of Agriculture, and the U. S. Department of the Treasury, Mr. Stackable was directed by the latter department to withhold delivery of the rice until after fumigation and report by your entomologist that the work was satisfactory. We soon used up all the carbon bi-sulphide to be had in town and sent a cable message to San Francisco for two hundred pounds more, which arrived at the end of October. During the intermission we tested the efficacy of hydrocyanic acid gas in a large chamber, using an ingeniously contrived outfit so as to avoid the possible danger of inhaling any of that deadly gas. Large tubs were used, in each of which was placed a ten gallon wooden tub, and into the latter was poured the necessary amount of water, and commercial sulphuric acid. Over each of these tubs was suspended by a strong cord a paper sack containing ten pounds of 98°-99° per cent. cyanide of potassium. In all, one hundred pounds were used at one charge. The method referred to above, so as to avoid any danger to the operators, was to extend the cord from each tub distributed in the chamber, to the door where they were screwed. The farthest package of cyanide was lowered first, and when all were lowered, the door was closed and sealed with paper and paste and remained closed for thirty-six hours, after which it was ventilated by the aid of a powerful electric fan. Upon examination it was observed, however, that this gas did not penetrate the grain as thoroughly as the carbon bi-sulphide did, and several of the larvae and weevils were still alive; so the chamber was again sealed up and remained until the arrival of the bi-sulphide; with the latter the work was throughly done. In all, we fumigated 22,924 sacks of Japanese rice. The importers paid for the chemicals and the work in handling the sacks. No damage

to the grain is caused by the fumigation, either in its value as a food or its germinative power.

SOIL BALLAST CONDEMNED.

On Sunday, July 15th, the large four-masted American iron ship "Atlas," arrived from Yokohama, with a cargo of soil ballast containing vegetable matter and roots. As the laws of this Territory, and your regulations positively prohibit the landing of such material, we notified the Master and the Agents of the vessel that they would have to discharge her cargo of ballast into the ocean outside the harbor. After some objections on the part of the representatives of the vessel the regulations were finally complied with.

NEW FUMIGATORY.

When it was found necessary to fumigate packages arriving by mail we have heretofore had to remove them to one of our fumigatories on the docks. To expedite this work we, with the Executive Officer's consent and Postmaster Pratt's permission, have now an outfit in the postoffice. As we use chemical gases, no building is in danger of fire from their use.

IMPROVEMENT IN OUR FUMIGATORIES.

Our fumigatories are now all fitted up so that we can use heavy as well as light gases, enabling us to treat grape roots whene there is danger of introducing *Phylloxera* thereon. These insects are very small and have a preference to locate under the rough bark on the roots, but when treated with carbon bi-sulphide before they are planted, nothing of that kind can escape.

PRACTICALLY NO DAMAGE FROM FUMIGATION.

We are frequently informed by parties that have received plants—more especially small plants by mail—that their plants were killed by fumigation; whereas, the fact is, that very seldom plants or fruit when treated in our fumigatories are even injured, as we fully understand the amount of gas each species will stand, and the exact number of cubic feet in the fumigatory is known, whereas in the treatment of trees or shrubs growing out doors, the space under the tents has to be estimated. Parties receiving plants seldom or never take into consideration that their plants have been in transit, under conditions other than natural, from eight to twenty days. In most instances with such plants

as heliotrope, etc., the roots are sometimes dried and shriveled up, and other plants are packed tight in boxes with all their foliage, to heat and rot, arriving in anything but growing condition and instead of their being injured by the inspectors, or by fumigation, we frequently are the means of rescuing plants from death, by removing the rotted leaves or stems, or by applying a little moisture to those that are suffering from lack of it. The Postmaster or one of his assistants' attention is always called to packages when they arrive in bad condition.

INSECTS AND OTHER PESTS FOUND UPON IMPORTATIONS.

I will here briefly enumerate some of the pests that have been stopped the past year. Among scale insects we found some lemon trees arriving in January, by mail from Florida, that were infested by a white wax scale (*Ceroplastes floridensis*). The owner's attention was called to the condition of the trees, after which they were burned. On the S. S. "Hong Kong Maru" that arrived on the 23rd of October, fourteen small tea plants were found infested with this same scale from Japan, and destroyed. Another importation of five tea plants from Japan in May, were infested with the partial "mining scale" (*Pseudaonidia duplex*). This pest also attacks orange trees, camellias and a great variety of shrubs. In the same package was a plant of *Lespedeza bicolor*, a low growing shrub with small violet-purple flowers, that was completely covered with a species of *Aspidiotus* scale unknown to me. This and the tea plants were destroyed by fire; the balance of the plants in the case were fumigated with hydrocyanic acid gas. Two tea plants and a *Sanchezia* plant came by mail from Florida infested with scale insects about the same time and were also burned.

Retinosporas are generally free from scale insects, but a plant that came from Japan was found with a colony of healthy *Dactylopius* sp. that appeared to thrive on that plant as a food. The tree was destroyed; a sample of the infested plant was put up in a tube as an office specimen.

INFESTED ORANGE TREES. On a shipment of citrus trees from California, we found some larvae of "black" and "cottony cushion" scales, and after a thorough fumigation the trees were passed; we already have both species on the Islands, together with their natural enemies and parasites that keep them in check.

ORTHEZIA INSIGNIS. A package of plants was received by mail, in which we found a *Salvia* plant infested with the so-called "Maui Blight" (*Orthezia insignis*), figured on page 127 of your report for 1905. This plant was destroyed. Unfortunately this insect has been widely distribubted by stockmen in the hope that it would kill out the Lantana plant that was rapidly destroying their pasture lands. While it checked the vigor of the Lantana it in no case destroyed it like the insects that were introduced specially for that purpose. The *Orthezia* unfortunately seriously attacks a variety of economic trees and plants. The *Salvia*, above referred to, was destroyed and the owner and shipper were both notified.

OTHER PESTS. Besides the foregoing scale insects, we have found on imported trees and fruit samples of several species of scale insects that are already well established on the Islands, including the disastrous "purple" (*Lepidosaphes beckii*), the "Florida red" (*Chrysomphalus ficus*), the "orange red" (*Aspidiotus aurantii*), and that white pest (*Pseudococcus nipae*) of the "Alligator pear." A consignment of plants arrived from Cuba that was slightly infested with the latter pest. This was my first knowledge of the existence of that pest there. Its apparently limited numbers there may be accounted for either by parasitic checks or by recent introduction. An effective parasite for this pest would be of incalculable value to this Territory, and Mr. Koebele's attention will be called to its existence there.

Besides scale insects, we occasionaly find vegetables or plants infested with larvae or egg clusters of insects, which are either destroyed or fumigated. In the case of trees or plants, these borers are always dug out or the infested plants are burned. In this class we have destroyed trees from the Southern States which were infested with larvae of the "peach root borer" (*Sanninoidea exitiosa*). We have even found small trees by mail infested by the same pest.

FUNGUS DISEASES.

Various fungi have been detected upon plants, trees and fruits coming from outside the Territory, and all such have been destroyed. These included plum, orange and other plants, also sugar cane.

SUGAR CANE PESTS.

A consignment of sugar cane arrived May 8th ex S. S. "Manchuria" from Formosa, via Hong Kong. As a precaution we fumigated the case before unpacking it to guard against the possible escape of any insects that had hatched on the voyage. Upon subsequent inspection frequent evidence of small borers was found. The cane was also black in places from the "honey dew" exuded by mealy bugs secreted under the base of leaves. Under the circumstances it was deemed necessary to burn the cane, including the packages.

During my vacation in August my assistants, Messrs. Kotinsky and Austin, intercepted another importation of sugar cane cuttings, which on this occasion came from Fiji ex S. S. "Miowera." These, after fumigation, showed signs of having been punctured by leaf and cane hoppers. The cane was burned not only on this account, but because of unmistakable signs of fungi on the stalks. I have since learned from a resident in Fiji of the existence of a very serious fungus disease in sugar cane on that island.

On December 20th, two packages of sugar cane cuttings arrived by mail from Florida. The cane was very slender and in sampling, it evidently contained a very low percentage of saccharine matter. The cane was discolored in places evidently by some insect. The cane and packages were burned.

INFESTED MANGO SEED.

On Sunday, June 10th, the transport Sheridan arrived from Manila. In her mail was a tin box of mango seed packed in charcoal. Upon inspection the seeds were found to be badly infested with small eight-legged silvery mites. The owner was notified and the condition of the seed was shown him, after which the entire lot, also the packages and wrappers, were burned.

LOCAL INSPECTION WORK.

MANGO WEEVIL.

In my weekly report to you of October 2, 1905, I called your attention to the existence of a mango fruit pest in two sections of Oahu. Mr. Austin and I immediately visited these districts, but found the crop of mangoes over for that season. Upon examination of a few fallen dry seeds under the trees we discovered several larvae and beetles, afterwards identified as *Cryptorhynchus mangiferae,* Fabr. We called the attention of the Superintendent of the estates to the existence of the pest, and requested him to have all the seed collected and burned, which was done.

During the past season Mr. Austin and I made a careful examination of the cultivated mango trees on Oahu, and found the above pest distributed from Palama valley to within a mile of Pearl City. During the fall of 1905, Mr. Van Dine first called attention to its existence on Oahu, and his estimate then was that sixty per cent. of the fruit in the original district was infected. An elderly Hawaiian living at the head of a small valley which we visited on our investigating trip, stated that he had known of its existence in his mangoes three seasons before our visit. From the enormous size of the trees and the character of the undergrowth and soil I fear that it is too late to attempt the extermination of this pest. As the weevil is found inside the seed, there appears to be very little damage done other than destroying its germinating power.

AN EFFORT TO EXTERMINATE THE INDIAN MANGO SCALES.

Previous to the enactment of the Plant Inspection law a shipment of Indian mango trees was imported and planted without fumigation, and during this summer they were found to be infested with the "mango scale" (*Coccus mangiferae,* Green), and a small white undescribed species resembling a *Pollinia.* Last August, obeying your orders, the trees were all fumigated with hydrocyanic acid gas. The trees were then making some new wood and the work was performed after sun down to prevent any serious injury from the actinic rays. Even with this precaution a slight scorching of the very tender twigs was noticeable, but two weeks later a thrifty new growth was sprouting all over the fumigated trees; and, what

was more satisfactory, was the fact that upon further examination we failed to find a single living scale of either species. All immediately adjacent mango trees were also fumigated.

NEW SCALE INSECT.

In October a small package was received at this office from Kauai containing a twig of "Norfolk Island Pine" (*Araucaria excelsa*) infested with a cottony scale which Mr. Kotinsky determined to be *Pseudococcus aurilanatus*. This scale is a native of Australia, and was occasionally found upon small Araucarias entering San Francisco, but they succumbed readily to fumigation. The owner reported that he had found the scale on two small Araucarias that he had received by mail. He was advised to dip the trees in whale oil soap solution, which was done, and he afterwards sent sample twigs showing that the scales were all dead.

INTRODUCTION, BREEDING AND DISTRIBUTION OF BENEFICIAL INSECTS.

This section of work which has continued in charge of Assistant Entomologist Jacob Kotinsky, has progressed satisfactorily during the past year. The work has largely been the care, breeding and distribution of beneficial insects, including new importations, recently established species, as well as some of the older established forms. Other features of the work have been the study of injurious insects, especialy scale insects, and their enemies; the usual routine of biological and systematic work; correspondence and imparting information to visitors.

NEW IMPORTATIONS OF BENEFICIAL INSECTS.

In all, 14 consignments of useful insects were received during the year. Besides the collections sent in by Mr. A. Koebele from California and Arizona, we were also favored with one colony of ladybirds from California by Mr. E. M. Ehrhorn; one of ladybirds from Fiji by Mr. F. Muir, of the Hawaiian Sugar Planters' Association Experiment Station; and five colonies of scale enemies from China and Japan by Mr. Geo. Compere. Grouped according to host, these new six-footed immigrants may be classified as enemies of (*a*) horn fly, (*b*) scale bugs, (*c*) aphis or plant lice, and (*d*) army and cut worms.

(*a*) **ENEMIES OF HORN FLY.**

By far the largest and most numerous consignments of beneficial insects received during the year were enemies of the horn fly. These comprised an extensive variety of predators and two species of parasites. Neither of the latter, so far as could be ascertained, is a specific enemy of the horn fly, though one of them, referred to later as the "Arizona dung-fly parasite," was bred from horn fly pupae. The predators were beetles that habitually either live in cattle dung and feed upon the living maggots therein, or "tumble bugs" which disintegrate the dropping shortly after deposition, thus preventing the breeding of flies therein.

The Arizona Dung-Fly Parasite (*Eucoila impatiens,* Say.) In his search for useful insects for the Territory, Mr. Koebele has concentrated his attention on the horn fly, taking enemies of our other pests, as Avocado pear scale and cutworms, incidentally. On the 5th of May, of this year, the "Alameda" brought, among other things, a box with dipterous pupae collected in dung in the vicinity of Nogales, Arizona. They were packed in sphagnum moss and kept at about 40° F. aboard the steamer. In the laboratory they were gradually brought to our normal temperature, and then segregated and put away for breeding. A little less than a month later males and females (Fig. 1) of the above named parasite began to issue. They were immediately supplied with two large jars full of cattle droppings well stocked with dipterous larvae and pupae that usually inhabit it. As fast as other specimens of the parasite issued they were placed in these jars. Twenty-five days later a large brood of the parasite made its appearance in the jars, and systematic distribution among ranchmen on the Islands and at

Fig. 1. Arizona horn fly parasite (*Eucoila impatiens,* Say): *a,* female; *b,* antenna of male. Both magnified 10 times. The natural size is given in the circle. (Original; by W. E. Chambers.)

the heads of the valleys in the vicinity of Honolulu immediately commenced. A portion of the brood was retained and two fresh jars stocked with it for further breeding and distribution. So far as we are aware, nearly all stock breeders on the Islands have been supplied with colonies of the useful insect.

It is now beyond doubt that the parasite does and will attack the horn fly larva and pupa, though it will probably show preference to the larger hosts breeding in the same medium. But even in the latter event it cannot but prove useful, both directly and indirectly. Directly, by reducing the numbers of the larger flies that inhabit cattle droppings. Indirectly by reducing the numbers of the larger maggots and pupae as a source of food to the mynah bird and other predators and thus compelling them to feed on the smaller fry, including horn fly larvae and pupae. No opportunity was yet open to ascertain whether the parasite has been established on the Islands, but the facility with which large numbers were bred in confinement encourages the hope that this useful ally will make itself at home on our Islands. Once established much of the success of its introduction will depend upon the intelligent manipulation by ranch managers and owners in distributing parasitized pupae over their respective lands.

For the identification of this fly we are indebted to Dr. W. H. Ashmead, through the courtesy of the U. S. Bureau of Entomology, Washington, D. C.

The Lesser Dung-Fly Parasite (*Eutrias* sp.). This is a small four-winged fly, in general appearance very much like the preceding parasite, though only about half the size. It was bred from dung-fly pupae sent by Mr. Koebele per "Sonoma," which arrived in Honolulu Aug. 11th. After securing Mr. Perkins' assurance that it is a dipterous parasite, a number were released, and others were retained in the laboratory for breeding purposes. Although exactly the same method of breeding was pursued as with the other parasite, no results were forthcoming.

Carrion and Dung Beetles (*Histeridae*). Each of the five consignments of desirable insects collected and sent by Mr. Koebele from Nogales, Arizona, contained a lot of these bettles in the pupa and adult stages. The immature forms were kept in the laboratory until maturity and then released. As indicated in the distribution table below, they were distributed over the Islands as widely as possible.

"Tumble-Bug" (*Copris carolina,* Linn.). Large numbers of this beetle were received alive and immediately released in suitable localities. This was the largest among the manure beetles received. It is dark brown, ungainly in appearance, almost an inch long, little less wide, and over half an inch thick (Fig. 2). "These insects act the part of scavengers by breaking up and burying the droppings of cattle and other animals. The female *Scarabaeus* detaches a portion of the dung and forms it into a ball, sometimes as large as the fist; this it rolls along by means of its hind legs, by pushing when necessary with its broad head, or by walking backwards and dragging the ball with its front legs. The strength and patience displayed by the creature in the execution of this task are admirable."*

Fig. 2. One of the Tumble bugs (*Copris carolina*, Linn.) from Arizona released on these Islands. (Original; photograph by Dr. Cobb.)

Other Manure Inhabiting Beetles. At least six other species of dung beetles were received and distributed. In distributing them, variety of climate was provided these immigrants in order to give them every possible opportunity for propagation and carrying on the good work for which they were intended.

(*b*) SCALE BUG ENEMIES.

Among our scale bug pests perhaps none attract more attention than the "Avocado mealy bug" (*Pseudococcus nipae,* Mask.), also known as "Alligator pear scale." As a matter of common observation this scale insect, which attacks also fig, banyan, bread-fruit, mulberry, guava and numerous other plants, is regularly each year,

* Sharp, Cambridge Nat. His., Insects II, p. 196

usually during the winter months, reduced to comparative non-importance by the black ladybird (*Rhizobius ventralis,* Ericks.). But when it gains the ascendency over its enemy during the summer it is very conspicuous by virtue of its white color, especially of the males, and becomes a subject of general complaint. For enemies of this, among scale insects, therefore, Mr. Koebele has given especial attention in his expeditions of the past year. Messrs. Muir, Ehrhorn and Compere also kindly assisted in this work by sending ladybirds that fed in their respective homes upon allied pests.

Following is a list of this group of insects received during the year:

LADYBIRDS.	DIPTERA.	HYMENOPTERA.	NEUROPTERA.
Exochomus pilatei, Muls.	Syrphus.	A variety of chalcids and encyrtids.	Hemerobiid.
Exochomus marginipennis, Lec.	Geomyzid?		
Scymnids.			
Hyperaspis lateralis, Muls.			
Chilocorus cacti, Linn.			

Avocado Mealy Bug Enemies. The first named ladybird (*Exochomus pilatei,* Muls.) seemed a promising foe of the Avocado mealy bug, upon which it fed while under observation in the laboratory before being released. The Scymnids and *H. lateralis* were released in prodigious unmbers upon trees infested with this pernicious pest.

Numerous internal parasites (*Hymenopterous*) were bred from mealy bugs (*Ceroputo bahiae* and *Phenacoccus* sp.) sent by Mr. Koebele from California, and released, after eliminating hyperparasites and questionable species. A Dipteron (Geomyzid) and lace-wing fly (Hemerobiid) were also bred from this material and released. None of these having as yet been definitely named, specific mention is omitted.

Purple Scale Parasites. Two large consignments of carefully packed almond twigs thickly infested with what is doubtless

the "apple tree bark-louse" (*Lepidosaphes ulmi,* Linn.), or a closely allied species, were received from Hong Kong, China, sent by Mr. George Compere. From these a very pretty Chalcid (*Perissopterus* sp.) was bred and a number released upon trees infested with purple scale. These consignments were received August 14th and September 4th, respectively.

Mr. Muir has sent to Dr. Perkins, of the Hawaiian Sugar Planters' Entomological Division, citrus leaves infested with parasitized purple scale from China. We are informed that many parasites were bred and released by Dr. Perkins and staff.

Florida Red Scale Parasite. On September 4th, the "Nippon Maru" brought also a small Cycas plant thickly infested with the above scale (*Chrysomphalus aonidum,* Linn.=*Aspidiotus*

Fig. 3. *Chrysomphalus aonidum,* Linn., on bit of Cycas leaf from China, showing exit holes of parasite. The uncommon number of these holes (1 or 2 is the usual number in armored scale insects) indicates the probable effectiveness of the parasite. Magnified about 10 times.

Fig. 4. The Cycas with the above parasitized scale, potted, in the Government Nursery under an orange tree infested with the same scale. (Original; photographs by Jacob Kotinsky, arranged by E. M. Grosse.)

ficus, Ashm.) many of which showed 5-7 exit holes (Fig. 3) of a parasite. This plant came in good condition and after careful inspection was potted and placed beneath an orange tree (Fig. 4) well stocked with the scale.

Parasites of the Orange Red Scale (*Chrysomphalus aurantii,* Mask.) Two species of parasites were bred from this scale upon cuttings kindly left by Mr. Compere on his way to California aboard the "Nippon Maru," December 11, 1906. Several pairs of these parasites were released in the Government Nursery grounds on a tree infested with this scale. Of the two parasites one was a Chalcidoid, and the other a very pretty Encyrtid.

(c) ENEMY OF APHIS OR PLANT LICE.

Fijian Ladybird (*Arcaioneda tricolor,* var. *fijiensis,* Crotch). If established this will be the largest ladybird on the Islands, being about 8 mm. (1/3 in.) long, 7 mm. wide and 3 mm. high, or about twice as large as the red spotted ladybird (*Coccinella repanda*). It is light brown ochre in color with a narrow black stripe on the medio-dorsal line. The eggs, laid in batches of a dozen or less, and the larvae, are proportionately large, the latter being in addition armed closely with heavy spines and gaudily colored with transverse bands of orange and purple.

On February 12 we were presented by the H. S. P. A. Experiment Station entomologists with 10 adults, a number of larvae in various stages and egg batches of this ladybird. These were successfully bred in the laboratory until the middle of May, and the adults distributed from time to time. Here they were fed entirely upon aphis principally from sorghum. At no time were they observed to eat mealy bug, although they were confined with it for days, and Mr. Muir, who collected them in Fiji, has found them upon mealy bugs. About 30 days was consumed in the development from egg to imago, and on an average about 25 per cent. of the eggs under observation reached maturity.

(d) ARMY AND CUT WORM ENEMIES.

Several consignments of very large, black, flattish ground beetles (*Carabidae, Calosoma* spp.) (Fig. 5) were sent by Mr. Koebele from Arizona. These are predaceous insects that in the young and full grown stages habitually feed on other

insects, particularly caterpillars in or close to the ground. Many of these were released in suitable localities.

Fig. 5. One of the ground beetles (*Calosoma* sp.) from Arizona released on these Islands. (Original; photograph by Jacob Kotinsky.)

RESULTS TO BE EXPECTED.

Time alone will tell the result of the release of these various insects. This result, however, can only be either positive or neutral, depending upon whether or not the insects are established and how rapidly they increase. No evil effects need be apprehended for the reason that all the insects released were of either predaceous or parasitic habit, and no insect is known to abandon carnivorous diet for vegetarian.

PREVIOUSLY ESTABLISHED BENEFICIAL INSECTS.

Siphanta or Torpedo Bug Parasite (*Aphanomerus pusillus*, Perk.) This useful little ally reported last year as established and doing effective work in its new home, has since been found thoroughly established on a coffee plantation on this Island and numerous colonies were sent from there to Hamakua, Hilo and Kona, Hawaii, and Haiku, Maui. At the Forester's Cottage up Nuuanu Valley, where formerly Siphanta was exceedingly

abundant upon the Eugenia trees, it is now a decidedly uncommon insect, so thorough has been the work of the parasite.

EXPERIMENT WITH THE JAPANESE BEETLE.

(*Adoretus umbrosus,* var. *tenuimaculatus,* Waterh.) Upon returning from Fiji, Mr. Muir reported the cacao plants of that country saved from the ravages of a beetle closely allied to the above, by means of a fence of bamboo sticks about 1 inch in diameter, placed 1½ inches apart, 3 or 4 inches from the plants and rising about 10 inches above the plant.

Fig. 6. These vines were grown indoors and placed in June in the Government Nursery grounds near a grape arbor badly infested with Japanese beetles, and a ¾ inch. mesh screen placed over one of them, as shown in the illustration. The photograph was taken ten days later. But the beetles were too much even for the screen for it was subsequently penetrated by them and the vine ruined. (Original; photograph by Jacob Kotinsky.)

To ascertain the effect of a similar fence upon our very much abused rose bushes by the Japanese beetle, lath and ¾-inch mesh wire screens were used in the construction of similar fences. At

first the results were quite encouraging, as illustrated by the photograph (Fig. 6) which was taken 10 days after putting up

Fig. 7. This lath paling (the laths are 1½ in. wide and 1½ in. apart) was built about the rose bush last June. The photograph was taken in December. Part of the fence was removed to expose to advantage the rose bush within. It will be observed that the leaves within the fence were scarcely touched by the beetles, though they were somewhat injured by tailor bees (the round cuts). The only explanation to this fact that can be offered is that the beetles are apparently reluctant to pass the barrier. The branch above the fence was stripped by the beetles, yet this branch was able to make the growth because of the protection afforded in early development, since an identical rose (not shown in the illustration) made no headway at all for the beetles. The advantage of the fence over a lath house for roses is that it is much cheaper and allows the tops of the bushes to remain open and exposed to the sun,—an important factor in rose culture. (Original: photograph by Jacob Kotinsky.)

the experiment. The day following, however, the beetles penetrated the screen and commenced the destruction of the plant. The photograph of the rose (Fig. 7) shows, however, that in the long run a certain degree of protection is afforded the plant that is fenced in.

COLONIES OF BENEFICIAL INSECTS DISTRIBUTED DURING 1906.

Name.	Hawaii	Maui	Molokai	Oahu	Kauai
HORN FLY ENEMIES.					
Arizona dung fly parasite (*Eucoila impatiens* Say)	19	11	5	26	12
Histers	1	2	1	5	....
Manure beetles	26	12	12	19	25

Name.	Hawaii	Maui	Molokai	Oahu	Kauai
SCALE BUG AND APHIS ENEMIES.					
Fijian ladybird (*A. fijiensis*)	....	2	....	8	1
Chalcaspis sp	....	....	....	6	....
Chalcidoidea (Misc.)	....	....	....	4	....
Cryptolaemus montrouzieri	....	....	....	1	....
Exochomus pilatei	...	....	....	1	....
E. marginipennis	....	....	....	2	....
Hemerobiid	....	....	....	6	....
H. lateralis	....	....	....	9	1
Perissopterus sp	....	....	....	2	....
Scale eating fly (Geomyzid)	...	....	....	6	....
Scymnids	....	....	....	2	....
Syrphus fly	....	...	....	2	....
Vedalia cardinalis	....	...	....	1	....
Parasite from Florida red scale (*Chrysomphalus aonidum* Linn.)	....	....	. ..	1	....
Parasites from Orange red scale (*Chrysomphalus aurantii* Mask.)	....	....	....	2	....
CUT WORM ENEMY.					
Calosoma spp.	2	2	1	3	1
MISCELLANEOUS.					
Siphanta egg parasite (*A. pusillus*)	18	....	....	1	....
Japanese beetle fungus	....	1	....	1	1
Lantana Insects	4	....	....	1	1

NOTE. It will be observed that the largest number of colonies of beneficial insects was released in Oahu, i. e., principally in and near Honolulu. The cause for this apparent partiality is obvious. If a useful insect is established it is desirable to have is as near the office as possible to facilitate further distribution. In the case of many insects immediate release is imperative and the best locality in the environs of the office was therefore chosen.

GENERAL REMARKS.

NEW FRUIT TREES. We have on various steamers to Brisbane, Queensland, forwarded packages of *Ceroplastes rubens* to Mr. Leslie G. Corrie, President of the Queensland Acclimatization Society, in hopes of introducing into that country the hymenopterous parasites that now keep that formerly damaging introduced scale insect in check on these Islands. In return for our efforts Mr. Corrie has very kindly

sent us—freight prepaid—three new mandarin orange trees of a variety that originated there and is considered to be the finest mandarin orange in the world. One of the trees was planted on the uplands of Tantalus; one in Nuuanu Valley and the other on the outskirts of Honolulu. This will thoroughly test their adaptability to various elevations. Buds will be taken later from them for general distribution. A variety of persimmon, a mango tree called "Rose," and three small coccus palm trees were also sent. We appreciate and thank Mr. Corrie for his kindness.

ECONOMIC PLANTS FROM WASHINGTON, D. C.

Four large cases of "cacao" (370 plants) and six small mango trees arrived ex S. S. "Alameda" from the Department of Agriculture, Washington, D. C., via San Francisco. The former from their appearance had been thoroughly treated with Bordeaux mixture to destroy any fungi spores; on the mango tree we found a few very small "Florida red scale" (*Chrysomphalus ficus*), which upon microscopic examination we found were dead, evidently having been fumigated before shipment.

A CEYLON SUGAR CANE PEST.

Mr. George Compere, the beneficial insect collector for California, passed through Honolulu, December 11th, on his way to California from India and the Orient. While in Ceylon he observed a very destructive leaf hopper on cane and brought samples of the larvae and imago in a vial of formalin; he presented me with a few which I gave to the Entomological Division of the Hawaiian Sugar Planters' Association. To be forewarned is to be forearmed, and sugar cane or similar plants coming from Ceylon will receive careful examination and treatment.

AN IMPORTATION OF FIBER PLANTS.

In February a resident of Oahu imported three cases—1000 plants—of New Zealand flax (*Phormium tenax*); a careful examination did not reveal any insects or fungi. However, we examined each plant and then fumigated them, also the cases and packing. It is a fiber plant and great quantities of the fiber in bales enters San Francisco on nearly every steamship from New Zealand. Mr. Byron O. Clark of Wahiawa, intends testing it to see if it cannot be profitably grown on these

Islands. As it requires better land and more moisture than sisal I doubt if it will be as profitable as that plant.

CHOICE LIMES. During November we received a package of limes from Mr. W. W. Taylor of Kipahulu, Maui, samples of which we have on exhibition; they compare favorably with Mexican or California grown limes and should be extensively grown, and would command good prices when California lemons are scarce.

DARK ROOM. The original fumigating house, figured on Plate VII of your report for 1905, located on your experimental grounds, has not been used for that purpose since the construction of other rooms on the docks, and has been converted into an up to date photographic "dark room" where the various divisions of your Board can develop their photographic plates of subjects pertaining to their work.

THE PORT OF HILO. With your consent, two fumigatories have been built at Hilo, on the Island of Hawaii, and a quarantine officer, Mr. B. M. Newell, was appointed by your Board in August to take charge. One fumigatory was constructed on the principal dock, and the other at the postoffice.

Respectfully submitted,

ALEXANDER CRAW,
Superintendent of Entomology and Inspector.

Report of Prof. A. Koebele.

Alameda, California, Dec. 31, 1906.

To the

Honorable Board of Agriculture and Forestry,
Honolulu, T. H.

GENTLEMEN:—I herewith submit some field notes on enemies of the Alligator pear scale, Hornfly and other insects, sent to Honolulu during the year.

The study of enemies of Leaf-hoppers has been continued in California, Arizona and Sonora, the result of which will appear elsewhere.

PARASITES AND PREDATORY INSECTS FORWARDED FOR *PSEUDOCOCCUS NIPAE.*

Several lots of a Coccid, related to the Alligator pear scale, found abundantly on *Salicornia* were sent, with the following insects breeding on the same:

(1) A Chalcid parasite, frequently met with, was contained in every parcel sent.

(2) Two species of *Hyperaspis,* of these *H. postica,* Lec., was by far the most numerous. The round species appears to be *H. limbatus,* Casey. The first named was found during the later part of 1893, on roots of a bunch grass infested with a Dactylopiid, in company with *H. depressa,* Casey, *Hyperaspidius comparatus,* Casey, and *Scymnus debilis,* Lec., all of which were sent to the Islands at that time. The last named has become very abundant around Honolulu. A small *Scymnus* was found quite numerous upon the Coccid on *Salicornia* and was sent to the Islands; it resembles *S. guttulatus,* Lec., which is found abundantly on *Adenostoma fasciculatum* and *Baccharis pillularis,* infested with Lecanium; it was sent to the Islands in large numbers some thirteen years since.

In Arizona and Sonora a number of useful ladybirds were found and forwarded. A common weed, *Ambrosia artemisiaefolia* was found here and there to be badly infested with a Coccid, *Dactylopius* sp., often in such masses as to almost obscure the upper part of the plant. On this large numbers of *Hyperaspis lateralis,* Muls., were present in all stages, and several consignments were made of this Coccid with large numbers of the *Hyperaspis* which—as Mr. Craw has been informed by letter —is badly attacked by a Chalcid parasite. This scale is also attacked by an internal parasite, which was sent, and may prove of value in the Islands. The same *Hyperaspis,* described under a number of specific names, was also kindly forwarded by Mr. Ehrhorn from San Francisco; and from Alameda, California, specimens were collected on *Adenostoma fasciculatum* infested with *Lecanium* and *Pulvinaria,* during the autumn in 1893. The trees in the parks at the City of Mexico are badly attacked by a Coccid (*Dactylopiid*) upon which a variety of this ladybird is found. At times it is seen in large numbers and at other times but rarely, when the largest part of the pupae are destroyed by a Chalcid parasite. Sendings from this locality were made at various times, to the Commissioner of Agriculture and during 1902 to Dr. Perkins.

Another species of *Hyperaspis* was found during spring in Arizona, breeding upon a Coccid infesting *Opuntia;* the same was forwarded in all stages on its original food.

Whenever *Quercus undulata,* which grows sparingly over the hills around Nogales, Arizona, was found to be infested by *Aspidiotus personatus,* Comst., *Chilochorus cacti,* Linn., was always present and breeding on the same. Specimens of this, as on previous occasions, were also sent. Another species was found upon the same oak tree, or rather more so on the variety *crisea,* Emgelm., breeding upon a species of *Kermes.* Some of this ladybird, *Exochomus pilatei,* Muls., were also sent. Another interesting Coccinellid that was sent is *Thalassa montezuma,* Muls.; on one occasion this was found in large numbers in larva and pupa state upon a mesquite tree, *Prosopis julifera,* feeding upon a large Lecaniid, *Toumeyella mirabilis,* Cock. This fact had previously been reported by the late Mr. H. S. Hubbard in the Proceedings of the Entomological Society of Washington,

Vol. IV, No. 3, p. 297. I have met with this insect in abundance on a similar, if not the same Coccid, upon *Acacia greggii* and *A. farnesiana,* at Cuautla, Morelos, Mexico, July, 1897. My notes do not show whether I sent the insect at that time.

During 1897 I collected a Coccinellid, of the Exoplectrae group, feeding upon an *Icerya,* in the State of Morelos, Mexico, and had then been informed by Mr. Schwarz that it was a species of *Chnoodes.* These are South American insects, a few species only have been taken in Mexico. In southern Arizona, *Icerya rileyi* was found upon several species of Mimosa, including mesquite, *Prosopis juliflora.* It is often riddled with holes from which a *Chalcid* parasite has issued, and the latter was bred in large numbers. This is apparently a useful enemy and may with advantage be used against *I. purchasei.* A species of ladybird, similar to that found in Morelos, was also present in considerable numbers and breeding upon *I. rileyi* around Nogales and Benson, Arizona. I also had the larva of the same, from which four *Chalcid* parasites were bred. I consider this of sufficient importance to record, since this parasite may readily be imported, or appear on its own account, in any district where the *Vedalia cardinalis* has been introduced, upon the larva of which it would unquestionably breed and prevent its beneficial work. Should this ever be the case—and it may be expected at any time in southern California—we should have recourse to the deadly *Chalcid* parasite of *Icerya rileyi,* which even without the help of man, may find its way into the orchards of southern California, if it is not already present.

OTHER BENEFICIAL INSECTS.

Of other useful insects found and forwarded in large numbers is *Calosoma simplex,* Lec. If the establishment of the same on the Islands should be successful, this would be a valuable agent in reducing the countless numbers of the so-called cut worms. I have had ample opportunities to observe the habits of these beetles. Being more or less nocturnal insects, they are attracted to the light during the evening in large numbers, where, amongst the hosts of various other creatures similarly attracted, they can gratify their insatiable appetite. Hardly any insect, that

may sit around on the ground, is safe from their attacks. Small moths are usually an easy prey, even the numerous lively crickets are often attacked and after a few rough tumbles are overcome, any injured and helpless moth, however large, is devoured by them. Often some of these beetles would run over the walls full of resting *Sphingidae,* and it was repeatedly observed that this *Calosoma* would deliberately fasten its mandibles into, even such a large moth as *Protoparce 5-maculata,* Haworth, when both would fall to the ground and become separated again; yet undaunted, the beetle will renew its attack.

Calosoma scrutator, Fabr., was observed both in larva and mature stages. During spring, when the willow and cottonwood trees are covered with the larva of *Malacosoma,* the beetle and its larva are active by day and night under dead leaves at the base of the tree, always in wait for any larva that may come down to pupate. The beetle at this time can be seen at almost any time during the day, often ascending the trees in quest of larvae or cocoons of the above moth. I have fed them on the pupae and the usual meal consisted of some six or more. One of this *Calosoma* was kept in confinement for over three months (at which time it had to be killed on account of my departure) usually burying itself in the ground and becoming partly dormant, if food was not forthcoming, yet always becoming active again after devouring a few larvae of *Agrotis,* upon which it had been fed.

On a hot sunny day, June 17, 1906, while walking over a grass field in Sonoma County, California, a large coleopterous larva was noticed on top of the grass, exposed to the rays of the sun and with its head buried in a cocoon of one of the numerous *Malacosoma* present; it fed a few days longer on the same, entered the ground in a glass jar wherein it had been placed, and pupated. It produced the beetle twelve days later, yet remained in the ground a week longer; when it was taken out, it proved to be *Calosoma discors,* Lec.

A nocturnal tiger beetle, *Tetracha carolina,* Linn., or variety thereof, previously sent from Mexico, was also amongst the consignments.

THE HORN FLY.

Further enemies of the Horn fly (*Haematobia serrata*) were collected during the year and forwarded to Mr. Craw, mostly by means of puparia and maggots of flies that breed within manure, and produce internal parasites. More of the manure beetles were sent from Arizona and Sonora; of these I should expect the best results from a species of *Pinotus* (sent previously from the States of Morelos Mexico, with a host of other species found in that locality) which with *Canthon* and *Copris* comprised the sendings.

In Europe the value of Histerids as enemies of the Horn fly has long been recognized and a considerable number of the same were sent, some two or more species. What appears to be the larva of the large forms in Arizona was often present in considerable numbers in dung droppings of a few days old or in the ground below the same, at a time when the maggots are most abundant. These larvae were sent to be bred.

The mature beetle appears shortly after the manure is dropped, and may be found anywhere within or beneath the same, where it deposits its eggs. Within a week's time full grown larvae are already present, often in such numbers as to destroy every single maggot, not within the manure alone, but also in the soil, since repeated and careful examination of the ground to a depth of some five inches failed to reveal either maggots or puparia, though there were always plenty of these *Hister* larvae in search of those maggots, that had entered ground for pupation. Some two dozen of these larvae will take care of the entire lot of the various species of fly maggots that may breed in one dung dropping. I refer only to those larvae sent to breed. When full grown they construct a rather hard roundish cocoon out of earth, from two to five inches below the surface, and pupate herein.

I did not find time to breed the mature insect from this larva, yet so much material has been sent, that it should be an easy matter to do so in your laboratory, and we should not fail to establish this beetle on the Islands, providing the conditions are suitable.

Besides this *Hister,* two or more species of Carabidae, *Anisodactylus* sp., were most always present under manure that had become partly dry, so that the maggots therein had begun to

leave the same and enter the ground. Most of these beetles were found burrowing in the soil at that depth where the fly maggots usually pupate, and it was but rarely that any puparia of the flies could be found, where this beetle was present.

In addition to the above predaceous insects there is another important agent in helping to keep the Horn fly in check. This is a small red ant, met with over large areas of ground; whenever present, and probably some sixty per cent. of the dung droppings will disclose the same, this ant will destroy every solitary insect that may breed in the manure; the ground below to any depth that the maggots may descend, is found swarming with it, and few, if any, of the puparia are exempt from destruction. This ant was not introduced, since the same conditions prevail on the Islands where *Pheidole megacephala* is so abundantly represented. With all the numerous enemies preying upon the Horn fly (there are many not enumerated here, for example the numerous Staphylinidae, and the internal parasites, which escape observation in the fields), the Horn fly is more or less a pest during a few months of the hot summer weather in California, Arizona and Sonora.

Respectfully,

A. Koebele.

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Report of the Commissioner of Agriculture and Forestry for 1900; 66 pp.
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* First Report of the Board of Commissioners of Agriculture and Forestry, from July 1, 1903, to December 31, 1904; 170 pp.
Second Report of the Board of Commissioners of Agriculture and Forestry, for the year ending December 31, 1905; 240 pp.; 8 plates; 10 text figures.
Third Report of the Board of Commissioners of Agriculture and Forestry, for the year ending December 31, 1906; 212 pp.; 3 plates; 4 maps; 7 text figures.
"Notice to Importers," by H. E. Cooper; 4 p.; 1903.
"Digest of the Statutes Relating to Importation, Soils, Plants, Fruits, Vegetables, etc., into the Territory of Hawaii." General Circular No. 1; 6 pp.
"Important Notice to Ship Owners, Fruit Importers and Others. Rules and Regulations Prohibiting the Introduction of Certain Pests and Animals into the Territory of Hawaii." General Circular No. 2; 3 pp.; 1904.

DIVISION OF ENTOMOLOGY.

"The Leaf-Hopper of the Sugar-Cane," by R. C. L. Perkins. Bulletin No. 1; 38 pp.; 1903.
* "On Some Diseases of Cane Specially Considered in Relation to the Leaf-Hopper Pest and to the Stripping of Cane," by R. C. L. Perkins. Press Bulletin No. 1; 4 pp.; 1904.
"A Circular of Information," by Jacob Kotinsky. Circular No. 1; 8 pp.; 1905.
"The Japanese Beetle Fungus," by Jacob Kotinsky and B. M. Newell. Circular No. 2; 4 pp., cut; 1905.
Report of the Division of Entomology, for the year ending December 31, 1905. Reprint from Second Report of the Board; 63 pp.; 3 plates; 10 text figures.
Report of the Division of Entomology, for the year ending December 31, 1906. Reprint from Third Report of the Board; 25 pp.; 7 text figures.

DIVISION OF FORESTRY.

* "Forest and Ornamental Tree Seed for Sale at Government Nursery." Press Bulletin No. 1; 3 pp.; 1905.
"Suggestions in Regard to the Arbor Day Tree Planting Contest." Press Bulletin No. 2; 7 pp.; 1905.
"An Offer of Practical Assistance to Tree Planters." Circular No. 1; 6 pp.; 1905.
"Revised List of Forest and Ornamental Tree Seed for Sale at the Government Nursery." Press Bulletin No. 3; 4 pp.; 1906.
"Instructions for Propagating and Planting Forest Trees." Press Bulletin No. 4; 4 pp.; 1906.
Report of the Division of Forestry, for the year ending December 31, 1905. Reprint from Second Report of the Board; 77 pp.; 5 plates.
Report of the Division of Forestry, for the year ending December 31, 1906.. Reprint from Third Report of the Board; 123 pp.; 4 maps.

DIVISION OF ANIMAL INDUSTRY.

"Inspection of Imported Live Stock." Rule 1; 1 p.; 1905.
"Inspection and Testing of Imported Live Stock for Glanders and Tuberculosis." Rule 2; 1 p.; 1905.
"Concerning Glandered Horse Stock in the Territory." Rule 3; 1 p.; 1905.
Report of the Division of Animal Industry, for the year ending December 31, 1905. Reprint from Second Report of the Board; 62 pp.
Report of the Division of Animal Industry, for the year ending December 31, 1906. Reprint from Third Report of the Board; 41 pp.; 3 plates.

DIVISION OF AGRICULTURE.

Report of the Division of Agriculture, for the year ending December 31, 1905. Reprint from Second Report of the Board; 12 pp.
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